CONSUMPTION OF FORTFIED FOODS AND ASSOCIATED DETERMINANTS BY CHILDREN AGED 6-23 MONTHS IN ISIOLO COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university. All sources have been duly acknowledged.

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DEDICATION

To my family, for their unwavering support during the entire period of the study. To my father, who instilled values of hard work and diligence.

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LIST OF ABBREVIATIONS AND ACRONYMS

CHP	Community Health Professional
DHS	Demographic and Health Survey
HH	Household
IDD	Iodine deficiency
KAP	Knowledge, Attitudes and Practices Survey
KEBS	Kenya National Bureau of Statistics
KNFFA	Kenya National Food Fortification Alliance
KNFFSP	Kenya National Food Fortification Strategic Plan
KNNAP	Kenya National Nutrition Action Plan
MOH	Ministry of Health
MUAC	Mid Upper Arm Circumference
NDMA	National Drought Management Authority
SMART	Standardized Monitoring and Assessment of Relief and Transitions
SSA	Sub-Sahara Africa
SQUEC	Semi-Quantitative Evaluation of Access and Coverage
USDA	United State Department of Agriculture
WHO	World Health Organization
VAD	Vitamin A deficiency

OPERATIONAL DEFINITIONS OF TERMS

Food fortification: Is the practice of increasing the content of micronutrient e.g., vitamins and minerals to a food to improve its nutrition quality and micronutrient value.

Consumption of fortified foods: Is the complementary feeding of fortified foods to infants and young children.

Fortified foods: Refers to flours and oils that are fortified based on legislation mandate.

Non-fortified flours and oils: Refers to flours and oils that should be fortified based on legislative mandate but are not.

Determinants: These are factors that affect the populations and an individual's choice of food.

Complementary feeding: Is the process of providing foods when breast milk or milk formula alone are no longer adequate to meet nutritional requirements, generally starts at age 6 months and continues until 23 months of age.

Availability of fortified foods: Refers to the presence and accessibility of fortified foods in the local market and at homesteads.

Home fortification with micronutrient powders: Introducing micronutrient powder (MNP) to meals to enrich meals with micronutrients. MNP mixed with complementary foods at home

Mandatory fortification: The Kenyan food fortification policy legally requires food manufacturers to add specific vitamins and minerals to

flours, oils and salt to improve public health and prevent nutrient deficiencies.

Food vehicle: Refers to a food that is selected for addition of a nutrient or nutrients during its normal processing (i.e., it "delivers" nutrient)

ABSTRACT

Micronutrient deficiencies remain a major public health challenge among young children, particularly in resource-constrained settings. Food fortification has been widely recognized as a cost-effective strategy to address these deficiencies. However, despite mandatory fortification policies in Kenya, gaps in awareness, access, and consumption persist especially among children aged 6–23 months. National data indicate that 36% of children are anemic, 61.8% are vitamin A deficient, 21.8% are iron deficient, and 83.3% are zinc deficient. In Isiolo County, 75% of children in this age group do not meet the Minimum Acceptable Diet (MAD). This study examined the influence of socio-economic status, availability of fortified foods, and caregiver knowledge on the consumption of fortified foods by children aged 6–23 months in Isiolo County. A cross-sectional survey involving 272 caregiver-child pairs and key informants (including shopkeepers) was conducted in the vulnerable wards of Oldonyiro and Ngaremara in August 2022. Cluster sampling was used to select villages, and simple random sampling was applied to identify participating households. Data collection tools included a semi-structured household questionnaire, focus group discussions, and key informant interviews. Quantitative data were analyzed using logistic regression at a 5% significance level. The study found that 89% of households were male-headed, with most of the caregivers aged 15–35 years. Over half (52.6%) of households were classified as having low economic status. Daily consumption of non-fortified maize flour and vegetable oil was nearly universal, while fortified versions were consumed by only 30% of children, typically twice per week. Households with higher socio-economic status (OR = 1.729, $p = 0.012$), greater caregiver knowledge (OR = 1.227, $p = 0.0089$), and better availability of fortified foods (OR = 1.311, $p = 0.015$) were significantly more likely to feed their children fortified foods. Notably, only 20.2% of caregivers were classified as knowledgeable about food fortification, and fortified products were less available in rural areas such as Oldonyiro. The findings underscore the critical role of socio-economic status, caregiver knowledge, and market availability in influencing fortified food consumption. Fortified foods already widely consumed in unfortified form represent a missed opportunity to improve child nutrition where dietary diversity is limited. Targeted interventions are recommended to raise caregiver knowledge, reduce economic barriers, and improve supply chain access to fortified foods in underserved areas.

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Under nutrition, characterized by wasting, stunting, and micronutrient deficiencies, remains a significant public health challenge globally, particularly in Sub-Saharan Africa (SSA) and Kenya. Globally, over two billion people are affected by micronutrient deficiency (WHO, 2020). In Kenya, iron, vitamin A, and zinc deficiencies significantly affect child health. According to the Kenya Demographic and Health Survey (KDHS, 2022), 36% of children aged 6–59 months are anemic, 61.8% are vitamin A deficient, and 83.3% are zinc deficient. In Isiolo County, 75% of children aged 6–23 months do not meet the Minimum Acceptable Diet (MAD), reflecting poor dietary diversity and inadequate nutrient intake (Isiolo SMART, 2023).

Isiolo County, located in Kenya's semi-arid northern region, faces distinct nutrition challenges driven by climatic and economic constraints. The county's predominantly pastoralist communities contend with limited agricultural productivity, irregular market access, and high poverty levels. These conditions exacerbate food insecurity and promote reliance on staple foods that are often energy-dense but lacking in essential micronutrients. A 2022 Ministry of Health market access report showed that only 35% of Isiolo retailers consistently stocked fortified maize flour, and less than 20% had fortified oil or micronutrient powders available.

The high burden of child malnutrition in Isiolo is compounded by poor maternal nutrition, inadequate breastfeeding practices, frequent childhood infections, and limited access to

quality health services. In this context, food fortification; adding micronutrients to widely consumed foods has emerged as a cost-effective and scalable strategy. Kenya adopted mandatory fortification of maize flour, wheat flour, and vegetable oil in 2012 through national policy frameworks. These foods were selected due to their high consumption rates and potential to reach vulnerable populations with essential nutrients. Although iodized salt remains an important fortified commodity, it was excluded from this study due to its near-universal coverage and minimal variation in access (MoH, 2022).

Despite these policy commitments, the uptake of fortified foods among children in rural and arid regions remains low. Disparities in consumption persist due to household economic status, availability in local markets, and caregiver knowledge. In Isiolo, many caregivers rely on non-fortified, locally milled flours due to affordability, accessibility, and limited awareness. Fortified products are more available in peri-urban areas and understocked in rural regions such as Oldonyiro due to supply chain constraints.

Core to this study are four interrelated variables: socio-economic status, availability of fortified foods, caregiver knowledge, and actual consumption. Socio-economic status influences food affordability and choice, while availability dictates access in local markets. Caregiver knowledge including recognition of fortified products and understanding their benefits shapes feeding decisions. Consumption is the outcome of these factors and a critical indicator of public health success in fortification.

This study therefore focused on children aged 6–23 months in Isiolo County to examine how socio-economic status, availability, and caregiver knowledge affect fortified food consumption. Additionally, given Kenya's ongoing commitment to fortification as a nutrition strategy, this study generates localized evidence to inform policy, programming, and advocacy targeting vulnerable child populations.

1.2 Statement of the problem

While national food fortification policies exist in Kenya, actual consumption of fortified foods among young children remains low, especially in rural arid areas. In Isiolo County, children aged 6–23 months face a triple burden: high rates of micronutrient deficiency, limited dietary diversity, and weak implementation of fortification interventions at the household level. According to the Isiolo KAP Survey (2017), only 23.1% of children consumed iron-rich or iron-fortified foods, and 87.6% of caregivers lacked knowledge of the benefits of vitamin-enriched foods.

Despite fortified maize flour and vegetable oil being mandated and available in some markets, uptake remains inconsistent. The underlying causes, whether economic constraints, limited availability in remote areas, or caregiver misconceptions remain unclear. Additionally, although iodine deficiency remains a national concern, salt was excluded from this study because prior research has already demonstrated high coverage of iodized salt in Kenya (94.6% according to MOH, 2021), whereas less is known about the coverage and consumption of the three selected vehicles: maize flour, wheat flour, and vegetable oil.

This study responds to the knowledge gap by investigating how socio-economic status, availability of fortified products, and caregiver knowledge influence the actual feeding of fortified foods to young children in Isiolo County. The findings aim to inform targeted policy interventions and improve complementary feeding outcomes in low-resource settings.

1.3 Purpose of the study

The purpose of this study was to generate evidence on the consumption of fortified foods among children aged 6–23 months in Isiolo County, and to explore how household socio-economic status, availability of fortified foods, and caregiver knowledge contribute to this consumption.

1.4 Objectives of the study

1.4.1 Main objective of the study

The main objective of this study was to assess the consumption of fortified foods among children aged 6–23 months in Isiolo County and to determine how socio-economic status, availability of fortified foods, and caregiver knowledge influence this consumption.

1.4.2 Specific objectives of the study

1. To establish the consumption patterns of fortified and non-fortified foods among children aged 6-23 months in Isiolo County.
2. To determine socio-economic status of households with children aged 6-23 months in Isiolo County.
3. To assess the availability of fortified and non-fortified foods in the markets and at home in Isiolo County.
4. To assess knowledge of food fortification among caregivers of children aged 6-23 months in Isiolo County.
5. To determine the association between the consumption of fortified foods and socio-economic status, availability, and caregiver knowledge.

1.5 Hypotheses of the study

1. **H_{01}** There is no significant association between HH's socio-economic status and the consumption of fortified foods by children below two years in Isiolo County.
2. **H_{02}** There is no significant association between availability of fortified foods and the consumption of fortified foods among children aged 6 to 23 months in Isiolo County.
3. **H_{03}** There is no significant association between caregiver’s knowledge of food fortification and the consumption of fortified foods among children aged 6 to 23 months in Isiolo County.

1.6 Justification of the study

Although food fortification has contributed to reduced micronutrient deficiencies at the national level, localized data especially in arid, underserved counties like Isiolo is lacking. Most previous studies have focused on household consumption of fortified foods or on adult awareness, without examining young children's actual intake or linking it to accessibility, knowledge, and economic barriers.

This study was important because it zoomed in on a highly vulnerable age group (6–23 months), a critical window for growth and brain development. It also explored determinants of consumption at the household level, including income levels, knowledge gaps, and access challenges in peri-urban versus rural settings. The results provide insights that can shape nutrition education, market interventions, and policy adjustments at county and national levels.

1.7 Significance of the study

This study provides crucial localized data on the consumption of fortified foods and its key determinants; socio-economic status, market availability, and caregiver knowledge within Isiolo County, a high need and underserved region. The findings will inform multiple stakeholders. Policy makers and program planners can use the results to update Kenya's Food Fortification Strategy and complementary feeding guidelines, while county health officials will gain evidence to enhance community-based nutrition education and market support interventions.

Implementing partners, such as NGOs and community health volunteers (CHVs), will benefit from insights into the barriers affecting fortified food access and uptake, which can guide awareness campaigns and livelihood initiatives. At the household level, caregivers and families will indirectly benefit through improved access, affordability, and awareness of fortified foods. Academically, this study contributes to the limited body of literature that connects fortified food consumption among children under two with specific contextual determinants. It also sheds light on the implementation gap between national food fortification policies and actual practices in arid and semi-arid regions like Isiolo.

1.8 Limitations and delimitations of the study

1.8.1 Limitation of the study

This study used a cross-sectional design, which limited the ability to assess seasonal variations in the availability and consumption of fortified foods. While the design allowed for valuable prevalence estimates, it does not account for potential fluctuations across different times of the year, which are common in arid regions like Isiolo. The study also did not measure total micronutrient intake or analyze the actual nutrient content of fortified foods consumed, focusing instead on behavioral and contextual determinants of consumption.

1.8.2 Delimitation of the study

The study focused specifically on three independent variables: socio-economic status, availability of fortified foods, and caregiver knowledge. Other potentially relevant factors

such as cultural beliefs, food pricing, maternal health practices, government nutrition programs, and the nutritional composition of consumed foods were outside the scope of this study. These exclusions were based on the need to maintain a manageable study focus and align with the available resources and timeframe.

1.8.3 Assumptions of the study

The study assumed that respondents, including caregivers and shopkeepers, provided honest and accurate information about the consumption and availability of fortified foods. Although this assumption carries inherent risk due to the self-reported nature of the data, trust-building techniques were employed during data collection, such as assuring participants of confidentiality, voluntary participation, and the anonymity of their responses. These measures were designed to reduce response bias and encourage truthful reporting.

1.9 Conceptual framework

This study is guided by the WHO 2021 conceptual framework for food fortification, which provides a structured approach to understanding the factors influencing the consumption of fortified foods. The framework emphasizes the interplay of personal and environmental factors in shaping nutritional outcomes, particularly in vulnerable populations such as children aged 6–23 months. In the context of this study, the framework was adapted to hypothesize three principal determinants of fortified food consumption: availability of fortified foods (environmental factor), household socioeconomic status (personal factor), and caregiver knowledge of food fortification (personal factor). These determinants were

used to design the study's methodology, guide data collection, and frame the analysis of how they correlate with the dependent variable consumption of fortified foods by young children.

Application to study design: The WHO 2021 framework informed the study's design by identifying key variables to investigate. The framework's focus on household-level monitoring of food fortification (provision, utilization, and coverage) was adapted to structure the research questions:

1. How does a household's socioeconomic status affect the likelihood of children consuming fortified foods?
2. Does the availability of fortified foods in local markets influence their consumption by children?
3. Does caregivers' knowledge of food fortification impact their decision to provide fortified foods to children?

These questions shaped the selection of independent variables (availability, socioeconomic status, and caregiver knowledge) and the dependent variable (consumption of fortified foods). The framework also guided the development of data collection tools, such as surveys to assess caregiver knowledge and market availability checklists to evaluate environmental factors.

Application to analysis: The WHO 2021 framework provided a lens for analyzing the relationships between independent and dependent variables. The study employed both

quantitative and qualitative methods to explore these relationships. For instance, regression analyses were used to quantify the correlation between socioeconomic status (measured by household income, education level, and occupation) and fortified food consumption. Focus group interviews with caregivers provided insights into how their knowledge influenced feeding practices. The framework's emphasis on environmental factors led to an analysis of market-level data to assess how availability and accessibility of fortified foods impacted consumption patterns. By integrating these analyses, the study tested the hypothesized relationships outlined in the framework, as illustrated in Figure 1.1.

Key hypotheses: The conceptual framework posits that:

1. Household socioeconomic status: Higher income, education, and stable occupations enable households to afford and prioritize fortified foods, positively influencing consumption.
2. Availability of fortified foods: Greater availability and accessibility in local markets increase the likelihood of children consuming fortified foods, provided other barriers (e.g., cost) are minimal.
3. Caregiver knowledge: Caregivers with better understanding of nutrition and the benefits of fortified foods are more likely to include them in their children's diets.

These hypotheses were tested to determine the strength and direction of relationships between the independent variables and the dependent variable. The framework also allowed for exploring potential interactions, such as whether high caregiver knowledge could offset limitations posed by low socioeconomic status or poor market availability.

Visual representation: The conceptual link between the independent variables (availability, socioeconomic status, caregiver knowledge) and the dependent variable (consumption of fortified foods) is depicted in Figure 1.1. This diagram, adapted from the WHO 2021 monitoring framework, illustrates how the three determinants interact to influence fortified food consumption at the household level.

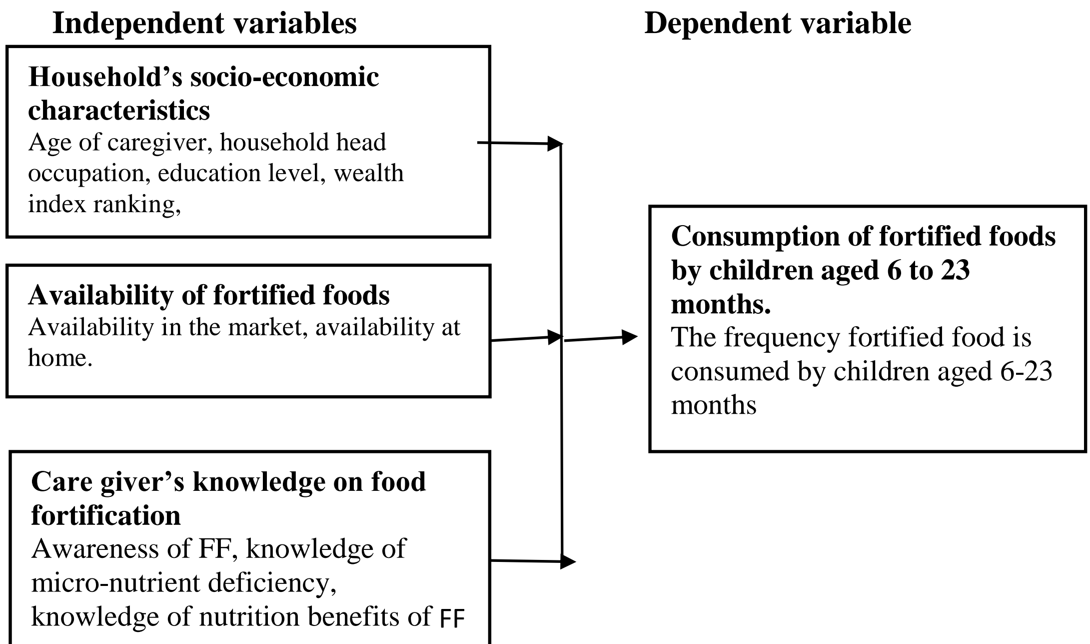

Figure 1. 1:

Conceptual framework on consumption of fortified foods by young children

Source: Adapted and modified from World Health Organization (2021), Monitoring framework on household-level monitoring of food fortification: provision, utilization, and coverage.

CHAPTER TWO: LITERATURE REVIEW

2.1 Fortified food uptake in low-resource settings

In many low-resource settings, including rural and marginalized areas of sub-Saharan Africa, the uptake of fortified foods remains inconsistent despite the existence of mandatory fortification policies. Multiple studies have highlighted that socioeconomic constraints, limited caregiver knowledge, and inadequate market penetration of fortified products impede the successful consumption of such foods at the household level (GAIN, 2020; Neufeld et al., 2017). For instance, Hotz et al. (2015) found that although fortified maize and oil were available in Uganda, their actual utilization was limited by factors such as cost, lack of awareness, and preference for unfortified locally milled products.

Similarly, in Kenya, disparities in access to fortified foods are evident across urban and rural contexts. According to the Ministry of Health (2018), fortified maize and wheat flour are more commonly consumed in urban and peri-urban areas due to better market access and product availability. Conversely, in rural and pastoral communities such as those in Isiolo County; locally milled flour, which is often unfortified, is more accessible and affordable, thereby reducing exposure to fortified commercial products. A study by Gelli, Webb, and Pambo (2017) also emphasized that even when fortified foods are available in local markets, affordability remains a key barrier for low-income households.

Moreover, limited awareness of the benefits of food fortification contributes to low uptake. Caregivers may not distinguish between fortified and non-fortified products or may lack knowledge of the micronutrient benefits these foods offer to children’s growth and

development (FAO, 2015). In a Kenyan context, only 20.2% of caregivers in Isiolo were found to be aware about food fortification (Isiolo SMART Survey, 2023), indicating a significant information gap that affects informed decision-making.

This body of literature underscores the complex interplay of structural, economic, and behavioral factors that affect fortified food uptake in low-resource environments. It further justifies the current study's focus on socio-economic status, availability, and caregiver knowledge as key determinants of fortified food consumption among children aged 6–23 months in Isiolo County, Kenya.

2.2 Background on food fortification in Kenya

Kenya's food fortification journey is rooted in global public health guidance, particularly the WHO's recommendation that effective fortification programs must target widely consumed foods in regions with known micronutrient deficiencies. These interventions must be regularly reviewed to ensure their continued relevance and effectiveness (Neufeld et al., 2017; Rohner et al., 2016; Verkaik-Kloosterman et al., 2017). In Kenya, the initiative began with the voluntary iodization of salt in 1972, which became mandatory in 1978. This move significantly reduced the national prevalence of goiter, from 35% in 1999 to just 6% by 2004. The success of salt iodization motivated companies such as Unga Ltd. to voluntarily fortify wheat and maize flour.

The shift from voluntary to mandatory fortification was formalized through legal reforms. In 2012, under the Food, Drugs and Chemical Substances Act (CAP 254, Notice No. 62),

the government mandated the fortification of vegetable oils with vitamin A, and wheat and maize flours with vitamin A, iron, zinc, and other micronutrients. This legislation was updated in 2015 (Notice No. 157) to align with East African Community (EAC) standards, ensuring consistency in food trade and nutritional requirements across the region. These standards required all packaged maize and wheat flours to be fortified with a specific set of vitamins and minerals, including iron, folic acid, and B-complex vitamins.

To support implementation, the Ministry of Health launched the Kenya National Food Fortification Strategic Plan (KNFFSP) 2018–2022. This plan is aligned with broader national policies such as the Kenya Health Sector Investment Plan (2013–2017), the National Food and Nutrition Security Policy (2017), and the Kenya National Nutrition Action Plan (2018). Food fortification is also designated as a flagship initiative under Kenya's Vision 2030. A social marketing and behavior change strategy developed in 2012 was also introduced to enhance public awareness and adoption.

Monitoring data show high compliance with salt iodization, with 94.6% of the population consuming iodized salt. However, comprehensive national data for other fortified food products remain lacking. Despite this gap, evidence suggests that the fortification program has significantly improved nutritional outcomes. A 2017 study found that the prevalence of vitamin A deficiency among children under five had dropped by 50%, and iron deficiency by 60% (MOH, 2018). This progress underscores the effectiveness of food fortification as a public health strategy and positions Kenya's model as a valuable example

for other countries seeking to improve nutritional quality and reduce micronutrient deficiencies through large-scale interventions.

2.3 Socio-economic status and consumption of fortified foods.

A household's socio-economic status significantly influences access to and consumption of fortified foods. Studies show that lower-income households tend to prioritize affordability over nutrient content, which limits their access to fortified products (GAIN, 2020; Mbogori et al., 2020; Githinji & Kinyua, 2021). In Kenya, disparities in socio-economic status play a central role in child nutrition, with poorer households more likely to suffer from stunting, wasting, and micronutrient deficiencies (KNBS & ICF, 2022; USAID, 2020). Rural areas like Isiolo experience additional barriers including limited market infrastructure and lower purchasing power, which collectively hinder access to fortified foods (Mwangi et al., 2018; World Bank, 2020).

Contrary to the assumption that improving income alone ensures better nutrition, studies such as Leyvraz et al. (2018) in Nairobi found that consumption patterns between poor and non-poor households did not differ significantly, suggesting the role of other factors like awareness and availability. Similarly, intra-household food distribution and prioritization may result in young children missing out even when fortified foods are available (Berner et al., 2014; Gyoeri et al., 2019; Ahmed et al., 2016). While socio-economic factors have been widely studied, little is known about how they specifically influence fortified food consumption among children aged 6–23 months in rural arid counties like Isiolo. This study addresses that gap.

2.4 Availability of fortified foods and consumption

Availability of fortified foods is a critical factor in influencing consumption patterns. Studies have shown that when fortified foods are readily available in markets, households are more likely to purchase and use them (Mwangi et al., 2018; Hotz et al., 2015; Hall et al., 2020). In Kenya, despite the 2012 Mandatory Food Fortification Program (Government of Kenya, 2012), many rural areas still struggle with inconsistent product availability due to infrastructure and supply chain limitations (Kimani-Murage et al., 2017; FAO, 2021).

In Isiolo County, availability is further constrained by geographic isolation and underdeveloped retail networks. Fortified products may be available in urban centers but remain scarce in rural areas such as Oldonyiro (MoH, 2018; KNBS et al., 2023; Save the Children, 2021). Moreover, assumptions that national-level fortification policies guarantee local access must be reviewed considering practical barriers like road access, storage conditions, and consumer demand (Mildon et al., 2015; Pambo, 2014; Gelli et al., 2017).

Studies like Fiedler & Macdonald (2009) and Micronutrient Initiative (2016) show that cost-effectiveness and scalability of last-mile distribution remains a challenge in Sub-Saharan Africa. Furthermore, informal markets often dominate rural food systems, limiting exposure to fortified goods (Njoroge & Kimiywe, 2020). Existing studies document national-level availability, but there is little empirical evidence on availability at the last-mile level in remote counties like Isiolo. This study explores that dimension.

2.5 Caregiver knowledge and consumption of fortified foods

Caregiver knowledge significantly affects the consumption of fortified foods by children. Awareness of fortification, understanding of nutritional benefits, and the ability to recognize fortified products all influence purchasing decisions (Linda et al., 2020; UNICEF, 2023; Bouis & Saltzman, 2017). In Isiolo, only 20.3% of caregivers are aware of food fortification (KNBS et al., 2023). Studies conducted in Ghana and Kenya have shown that caregiver knowledge—more than availability—strongly predicts consumption (Lartey et al., 2016; Mbogori et al., 2020; Ndemwa & Mbithe, 2021).

In rural Kenya, limited education levels and weak information dissemination channels hinder the effectiveness of national nutrition education campaigns. These gaps are particularly evident in arid counties like Isiolo, where literacy rates are lower and community health outreach is often inconsistent (GAIN, 2020; Save the Children, 2021). Poor understanding of food labeling and minimal nutrition counseling during child welfare visits contribute to underutilization of fortified foods (Ndemwa & Mbithe, 2021; Konyole et al., 2012).

Emerging evidence also highlights the role of traditional beliefs and cultural food norms as limiting factors in adoption (Darnton-Hill & Mkparu, 2015; FAO & WHO, 2019). Few studies have focused on caregiver knowledge of fortified foods in arid rural contexts. This study fills that gap by examining the knowledge levels of caregivers in Isiolo and how this influences child consumption patterns.

2.6 Summary of literature review

Existing literature affirms the importance of food fortification in addressing micronutrient deficiencies, particularly among children (WHO, 2023; Allen et al., 2006; Bhutta et al., 2013; Black et al., 2013). However, gaps remain in understanding how socio-economic status, market availability, and caregiver knowledge intersect to influence the consumption of fortified foods among children aged 6–23 months in Kenya's arid regions. This study is among the few that disaggregates these variables and focuses on a high-need, underserved area like Isiolo, offering localized insights to inform Kenya's broader fortification strategy.

Comprehensive reviews (Finkelstein et al., 2015; Horton & Ross, 2003) highlight the long-term benefits of iron and folic acid fortification in school-aged children and pregnant women. However, application to early childhood remains under-researched in arid contexts. Global cost-benefit analyses (Tontisirin et al., 2002; World Bank, 2020) affirm that early-life nutrition is one of the highest-return development investments.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Research design

The study adopted a cross-sectional analytical survey design employing both quantitative and qualitative data collection and analysis methods. Quantitative data were used to measure associations between variables, while qualitative data provided context and deeper understanding of factors influencing fortified food consumption.

3.2 Study variables

3.2.1 Dependent variable

The dependent variable was the Consumption of fortified foods by young children.

3.2.2 Independent variables

The independent variables for this study were availability of fortified foods, HH socio-economic status and caregiver's knowledge of food fortification.

3.3 Location of the study

The study was conducted in Isiolo County, specifically in Oldonyiro and Ngaremara Wards, purposively selected due to their high vulnerability to acute malnutrition and food insecurity, as documented in the Isiolo SMART survey (2020). These areas also represent rural and peri-urban contrasts in market access and livelihood patterns.

3.4 Study population

The study targeted households with children aged 6–23 months. The main respondent at the household level was the primary caregiver, typically the mother, who was responsible for child feeding. Additional respondents included key informants (e.g., shopkeepers, nutrition officers) and participants in focus group discussions (e.g., community health volunteers, mothers of young children).

3.4.1 Inclusion criteria

The study focused only on children below 23 months and their caregivers within Oldonyiro and Ngaremara ward.

3.4.2 Exclusion criteria

Households with children aged between 6-23 months who do not provide consent, children who were ill during the study and those away from the households during the period of the study were excluded.

3.5 Sampling techniques and sample size

3.5.1 Sample size determination

The size of sample was computed using Cochran (1963) formula for sample size determination with below parameters:

$$n_0 = \frac{Z^2pq}{e^2}$$

The design effect of 1.5 was used to cater for cluster heterogeneity (SMART, 2020). An average prevalence of 28% on Consumption of iron-rich and iron fortified foods. Precision of 8% was used since the prevalence rates are above 25% (KAP, 2017). The confidence level was set at 95%. A correction factor (2003) of 0.5 has been used. Using the Care 2010/IYCF step by step guideline, sample size was arrived at as shown in Table 3.1.

Table 3. 1: Sample size determination per age category

Indicator	Population	Prevalence	Precision	Design effect	Correction factor	Sample size
Children aged 6-11 months consuming iron rich/fortified foods	534	37.4	8	1.5	0.5	84
Children aged 12-17 months consuming iron rich/fortified foods	505	44.8	8	1.5	0.5	87
Children aged 18-23months consuming iron rich/fortified foods	460	48.6		1.5	0.5	86

The largest sample size of the three categories (87) was multiplied by 3 to allow for disaggregation into 3 age categories for children (6 – 11 months, 12 – 17 months and 18 – 23months) which were used during data analysis and for age group specific recommendations. Thus =87*3 = 261. To cater for non-response, 10% (26 children) were added to form a sample 287 Children.

The number of clusters to be sampled based on the previous nutrition surveys experience indicated that a team could assess 14 households per day. The clusters to be accessed were calculated as number of children divided by the number of children visited per day, making a total of 21. Thus, approximately 21 clusters were visited for the stud**y.**

3.5.2 Sampling techniques

Oldonyiro and Ngaremara were purposely selected based on Isiolo 2016-2020 short rains assessment and 2010-2020 acute malnutrition hot-spot mapping. Sampling frame was derived from the KNBS 2019 population data where the smallest administrative units with known population (village) were included hence referred to as clusters. The number of clusters to be sampled were based on the previous nutrition surveys experience that indicated a team can assess 14 households per day. ENA for SMART software was used to randomly sample the clusters to be visited with probability proportional to size (PPS) factored in selection of clusters.

Simple random sampling was used to select 14 households to be visited in each cluster. Households to be visited per cluster were randomly selected from the updated list of

households with children 6-23 months as guided by the community health volunteers. Absent and abandoned households were excluded from the list before sampling. Random number generator mobile application was used to randomly select the households.

Selection of the child within the sampled household: if there was only one eligible child 6–23 months of age within the sampled household, then he or she is selected automatically, if there are multiple eligible below 23 months of age, the youngest child was selected, and the respective caregiver was interviewed.

3.6 Data collection instruments

3.6.1: Focus group guide

A total of 2 FGDs – one per ward (Annex E) were conducted with 6–8 participants per group. Participants included mothers of children aged 6–23 months, community health volunteers, and local elders. Participants were selected purposively to ensure diverse perspectives. FGDs explored community perceptions, awareness, availability, and barriers to fortified food consumption.

3.6.2 Household questionnaire

The standardized Fortification Assessment Coverage Toolkit (FACT)-household questionnaire (Annex C) was adopted for this study. The research instrument has been validated and is widely used in similar studies in various countries (Assessment & Toolkit, 2019). The tool was administered face-to-face by trained enumerators to the primary

caregiver in each household. It captured data on household demographics, socio-economic indicators, caregiver knowledge of fortified foods, and frequency of fortified and non-fortified food consumption.

3.6.3: Key informant guide (KII)

KII (Annex D) was administered to complement quantitative data. 6 KIIs were conducted with shopkeepers, local nutritionists, and public health officers. Participants were purposively selected based on their knowledge of fortified food distribution and public health programming. Interviews captured insights on supply chain challenges, market availability, pricing, and community demand for fortified foods.

3.7 Pilot study and pre-testing

The household assessment tool was pre-tested a week before the research in a village that was not selected to participate in the study. 10% of the households within the research area were subjected to the pre-test; these households were not included in the main survey. This was to help in identifying questions that were not clear to respondents or not appropriate to the context to allow for modifications where necessary while providing an opportunity to test interview skills and understanding of the questionnaire by the research assistants and time taken to administer the same.

3.7.1 Validity

Validity of research tools were ensured using validated questionnaires as per the study objectives and validation by a panel of experts (supervisors).

3.7.2 Reliability

Test and retest method was used to test the ability of research questions to reproduce similar results. Correlation of responses were determined using Cronbach's Alpha(α) test for reliability (1951). A correlation coefficient above 0.7 meant that the instrument is reliable.

3.8 Data collection technique

Meetings with local authority and Ministry of Health (MOH)/nutritionist were held at the start of the activity to introduce the researcher and study details. This is aimed at eliciting acceptance and support for the activity in the ward. Three research assistants with a minimum diploma in nutrition or its equivalent were trained for 3 days on the study objectives, administration of the questionnaires, interview skills and research ethics using lectures, demonstrations, role plays and finally a pre-test.

3.9 Data analysis and presentation

Coded data from the questionnaires were cleaned using the Microsoft excel software before analysis using SPSS version 25 and analyzed as indicated in Table 3.1. The study results have been presented in the form of tables, charts and graphs for easy interpretation. Statistical significance set at $p < 0.05$. Qualitative data from the focus group discussions

(FGDs) and key informant interviews (KIIs) were transcribed, manually coded, and analyzed thematically. The analysis generated key themes related to barriers to access, caregiver attitudes, supply chain gaps, and suggestions for improvement. These emerging themes were subsequently triangulated with the quantitative findings to provide a richer and more comprehensive interpretation of the study results. Table 3.2 presents the data analysis matrix.

Table 3.2: Data analysis matrix

Objective	Variable	Type	Measurement	Analysis Method
1. To assess consumption of fortified and non-fortified foods	Consumption frequency	Categorical	Daily/Weekly/Never	Descriptive stats
2. To determine socio-economic status of households	SES index (PCA)	Composite	Asset ownership, housing type, water source	PCA, regression
3. To assess the availability of fortified and non-fortified foods	Availability score	Ordinal	Number of stocked items in shops/markets and at homes	Descriptive, regression
4. To assess caregiver knowledge on food fortification	Knowledge score	Ordinal	No. of correct answers (max 6) Percentage-based method Knowledge %= Maximum score Respondent's score ×100	Descriptive, cut-off scoring
5. To examine relationships between determinants and consumption	All above	Mixed	Cross-variable interaction	Logistic regression

3.10 Logistical and ethical considerations

Approval to carry out study was sought from Graduate School of Kenyatta University and research clearance from Kenyatta University Ethical Review Committee. Research permit and authorization letters were sought from National Commission for Science technology and Innovation (NACSTI), ward administration and MOH. The questionnaires which were administered to the participants were done based on voluntary informed consent and keeping personal information of respondents confidential.

CHAPTER FOUR: RESULTS

4.0: Demographic of households with children aged 6-23 months in Isiolo County

A total of 272 caregivers – child pair were interviewed from Oldonyiro and Ngaremara wards. 74% of caregivers interviewed were from Oldonyiro for representation; there are more people in Oldonyiro compared to Ngaremara.

Table 4.1 presents demographic characteristics of households in Ngaremara and Oldonyiro, Isiolo with children aged 6-23 months. Out of the 272 surveyed households, 89% were male-headed, and in 94% of households, the primary caregiver was the mother. Most households derived their livelihoods from pastoralism or informal trade. There was no significant age difference among children in various age categories, the majority fell within the 12-17 months' age range (34%). There is also no significant difference in gender among females (53%) and males (47%) children aged 6-23 months.Table 4.1).

Table 4. 1: Demographic characteristics of households in Isiolo County

Description		**Totals N=272**	
		n	**%**
Household Head	Male	241	89
	Female	31	11
Age of caregiver	15-35 years	174	64
	36-45 years	92	34
	>45 years	6	2
Mean-age of care givers		30.8	
Gender for children (6-23 months)	Male	129	47
	Female	143	53
Age distribution for children	6-11 months	88	32
	12-17 months	93	34
	18-23 months	91	33

4.1: Consumption of fortified and non-fortified maize, wheat flour and vegetable oil by children aged 6 to 23 months in Isiolo County

4.1.1: Frequency of consumption

Caregivers were asked to report on the frequency of consumption of maize flour, wheat flour, and vegetable oil by their children in the preceding seven days, with an additional 24-hour recall used to cross-check recent feeding patterns. Findings showed that fortified maize flour was consumed by 30.1% of children at least twice a week, while unfortified maize flour was consumed daily by 76.5%. Fortified vegetable oil was used in meals by 29.3% of children, compared to over 60% daily use of non-fortified vegetable oil. Wheat flour consumption was generally lower, with only 17.5% of children consuming food prepared with fortified wheat flour.

Key informant feedback revealed cost, availability, and familiarity as key influences on food choice, with one FGD participant from Oldonyiro noting, “Most of us prefer the local brands because they’re cheaper and easy to get. The fortified ones are expensive or missing in our shops.” Similarly, a County Nutrition Officer remarked, “During the drought, most people had cash transfers, but they still chose unfortified flour because it was cheaper.”

There was also widespread confusion among caregivers about what constituted fortified food, with some assuming that locally milled sifted flour was inherently nutritious. As one FGD participant from Ngaremara explained, “We don’t know which is which. Unless it's written in big letters, we just buy what we know.”

Table 4. 2: Consumption patterns of fortified and non-fortified foods by children aged 6-23 months in Isiolo County

Food stuff N=272	Fortified		Non – fortified		P-value
	Average days food is consumed	Median (range)	Average days food is consumed	Median(range)	
Maize flour	2	1.86 (0 – 7)	7	7.0 (7 – 7)	0.027*
Wheat flour	1	0.93 (0 – 7)	3	3.13 (0 – 7)	0.046*
Veg oil	2	1.94 (0 – 7)	7	6.94 (5 – 7)	0.031*

7-DAY recall, N= Total population size, (*) = Significant association at 0.05, p = [p-value] (Chi-square test for association between [fortified foods] and [non-fortified foods]).

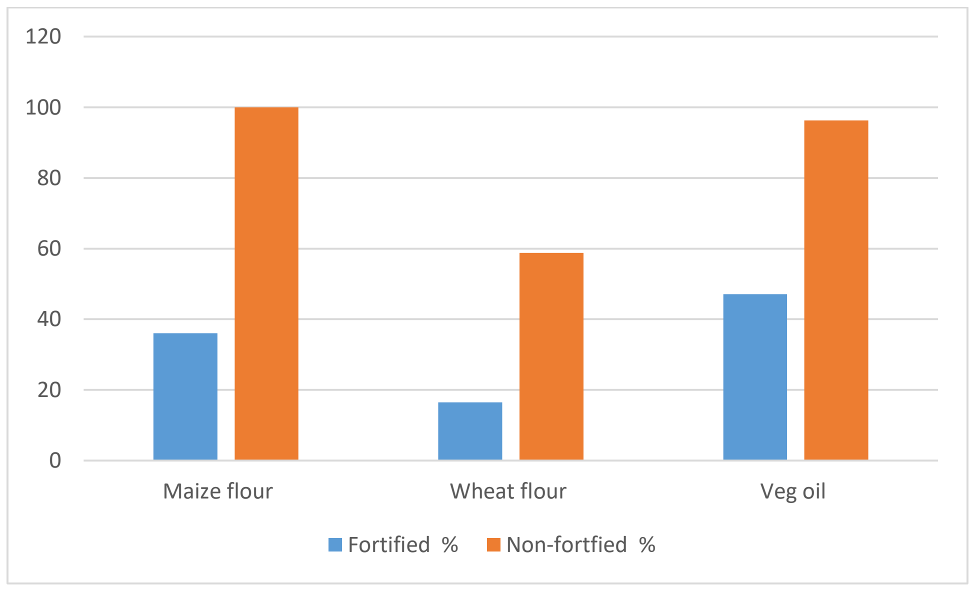

Figure 4. 1: Consumption of fortified and non-fortified food foods by children aged 6-23 months the previous day

4.1.2: Consumption of fortified and non-fortified foods by age groups

The 24-hour recall data presented in Table 4.2 shows the consumption of fortified and non-fortified maize flour, wheat flour, and vegetable oil by children in three age groups: 6–11 months, 12–17 months, and 18–23 months. Across all age groups, non-fortified maize flour and vegetable oil were more commonly consumed than their fortified counterparts. However, fortified food consumption generally increased with age. For example, fortified vegetable oil consumption was recorded at 40.7% among children aged 6–11 months, 48.9% among those aged 12–17 months, and 56% among children aged 18–23 months. Similar trends were observed for fortified maize flour and wheat flour, with older children more likely to consume fortified products.

Table 4.3: Consumption of fortified and non-fortified vegetable oil, maize and wheat flour by young children and by age group

Foods N=272		**6-11 months (N=88)**		**12-17 months (N=93)**		**18-23 months (N=91)**		**P- value Among age groups**
		n	%	n	%	n	%	
Maize flour	Non fortified	88	100	93	100	91	100	0.032*
	Fortified	23	28.4	34	37.8	41	45.1	
Wheat flour	Non fortified	51	58.0	55	59.1	54	59.3	0.254
	Fortified	5	6.2	11	12.2	29	31.9	
Veg oil	Non fortified	81	92.0	90	96.8	91	100	0.064*
	Fortified	33	40.7	44	48.9	51	56.0	

4.3: Socio-economic characteristics and economic status of households

4.3.1: Socio-economic characteristics

Livestock herding is the most prevalent occupation, with more than half of the household heads engaged in this activity (Chi square; p =0.032). Other occupations include farmer/own farm labor (14%), employed/salaried (11%) and daily labor/wage labor (15%). On asset ownership, 23% own agricultural land and 42% own livestock. A third of the respondents (33%) completed primary education, followed by pre-primary education (27%) and no formal education (23%).

Households in Isiolo have inadequate basic amenities; 74% of the households do not have electricity, 68% have inadequate toilet sanitation and 47% access water from unsafe water sources. Socio-economic status (SES) was computed using Principal Component Analysis (PCA) based on asset ownership (land and livestock), education, housing materials, water access, and fuel sources. The analysis revealed that 52.6% of households were classified as low SES, and higher SES was significantly associated with a greater likelihood of purchasing fortified products. As one FGD participant from Ngaremara remarked, "*Fortified foods are not for poor people. That's how we see it.*" (Table 4.4).

Table 4. 1: Socio-economic characteristics of households with children aged 6-23 months.

Description		**N=272**		**P- value**
		n	**%**	
Main occupation Of the HH head	Livestock herding	138	51	0.032*
	Farmer/own farm labor	39	14	
	Employed/salaried	30	11	
	Daily labor/wage labor	42	15	
	Small business/petty trade	23	9	
Education level Of care giver	No formal education	62	23	0.027*
	Pre-primary education	73	27	
	Primary education	90	33	
	Secondary education	27	10	
	College	18	7	
	Postgraduate	2	1	

(*) = Significant association at 5%, p = [p-value] (Chi-square test for association between [variables]).

Table 4.2: Economic status of households with children aged 6-23 months

Description	N=272		**P- value**
	n	**%**	
Asset ownership component			
Households owning agricultural land	62	**23**	
Households owning livestock	114	**42**	
Living standard component*			
Households that have no electricity	202	**74**	
Households that have inadequate flooring	208	**76**	
Households that have inadequate roofing	133	**49**	
Households with inadequate toilet sanitation	168	**68**	
Households that access water from unimproved water source	160	**47**	
Economic status/wealth ranking index			
Low economic status	143	52.6	
Medium economic status	97	35.6	
High economic status	32	11.8	

4.4: Availability of fortified and non-fortified maize, wheat flour and vegetable oil in the markets and at home

4.4.1: Market availability of fortified and non-fortified flours and vegetable oil

A total of 20 retailers were visited in the local markets to check on the availability of fortified and non-fortified foods in their stores. The highest proportion (75%) of the stores stocked fortified maize flour while 50% and 25% stocked fortified vegetable and wheat flour respectively.

Notably, there were higher stocks of fortifiable/ non-fortified flours and vegetable than that of their fortified versions (Table 4.6). From KII with shopkeepers, the reasons most cited

were the cost difference and more availability of locally milled flour and vegetable oil. Shop keepers also mentioned a lesser preference for wheat flour which accounted for low stocks. From a focused group discussion, 20% of the caregivers stated that milled flours were more available and cheaper which influenced their choice as they purchased the flours in the market. As one shopkeeper from Oldonyiro explained, *"Customers prefer the sifted maize flour from nearby mills. Fortified brands like Jogoo or Pembe don't sell as fast, and they're more expensive."*

Table 4. 3: Local market availability of fortified and non-fortified flour and vegetable oil

Description N= 20		n	%
Non-fortified foods present in the shop During the day of visit	Maize flour	20	100
	Wheat Flour	5	25
	Vegetable oil	15	75
Fortified foods present in the shop during day of visit	Maize flour	15	75
	Wheat Flour	5	25
	Vegetable oil	10	50

**Most of the non-fortified food available in Isiolo is from Meru and Nanyuki (veg oil)*
**There is no or very low purchase or sale of wheat flour in Oldonyiro*

4.4.2: Availability of fortified foods in households with children aged 6-23 months.

The availability and sources of fortified foods in the local markets and in the households during the day of visit and the willingness of households to feed their children fortified foods is presented in Table 4.7.

46.3% of the households reported availability of fortified foods in their local markets. The majority (73.3%) of these households reported obtaining the fortified foods from the market, while 19.8% reported obtained them from relatives or friends and 7.0% reported making them at home (mixing with micro-nutrient powder). 2). 46% of the care givers expressed a willingness to feed their children fortified foods. Of the 272 households visited; 73.5% had fortified vegetable oil while 37% and 22% had fortified maize and wheat flour present during the day of the visit respectively (Figure 4.2)

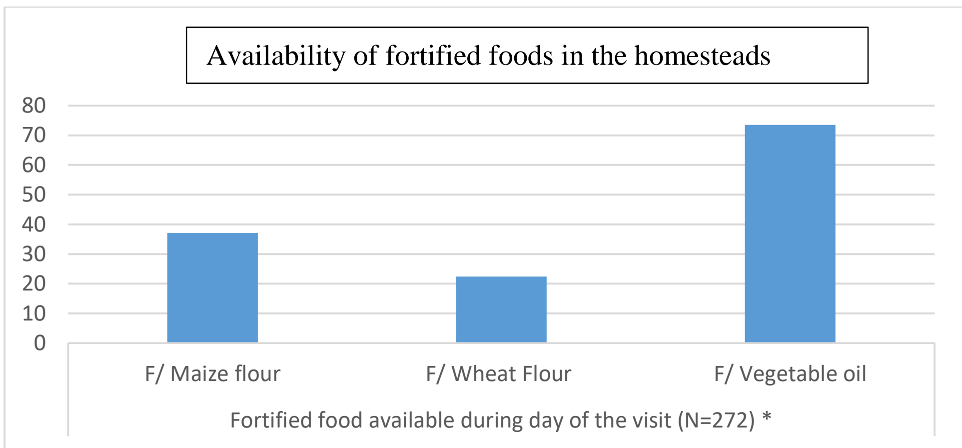

Figure 4. 2: Availability of fortified foods in households

Table 4.7: Market Availability, Sources, and Caregiver Willingness to Feed Fortified Foods to Children Aged 6–23 Months in Isiolo County (N=272)

Description	n	%
Fortified foods present in the local market (N=272)		
Yes	126	46.3
No	146	53.7
Sources of fortified foods (N=126*)		
Market	126	73.3
Home fortification (MNP)	12	7.0
Relatives/Friends	34	19.8
Willingness to feed fortified foods if available at home (N=272)		
Yes	126	46.3
No/Not sure	146	53.7

*Percentages for sources calculated based on the 126 respondents who reported availability of fortified foods

4.5: Caregivers' knowledge of food fortification among households with children aged 6-23 months in Isiolo County

Insights into the knowledge of food fortification among the respondents are provided in table 4.8 below. Knowledge level on food fortification in Isiolo is low, with only 20.2% of respondents being knowledgeable. Out of the 272 respondents, 126 (46.4%) reported that they have heard about food fortification. Among those who have heard of fortified foods, the most common sources of information are community health workers (97.6%) and health facilities/clinics (65.1%). Among those aware (N=126), all could list three examples of fortified foods, such as fortified maize flour, wheat flour and vegetable oil. However, only 77% could identify the Kenyan logo for food fortification and 2% could specify a micronutrient deficiency that fortification addresses. One FGD participant from Ngaremara noted, "*We hear about fortification in clinic talks, but we don't understand the details. It's not something we focus on.*"

When asked about the reasons why they should feed their child fortified foods, the most common responses were that it improves the body's ability to fight diseases (13.8%), makes the child healthy, strong and active (20.9%) and improves the child's ability to learn and develop (13.8%). Knowledge was measured on a 6-point scale, with a score of ≥5 classified as “knowledgeable.” Only 20.2% of caregivers met this threshold.

Table 4.8: Caregivers' knowledge of food fortification

Description		n	%
Heard about food fortification (N=272)	Yes	126	46.4
Sources of information on fortified foods (N=126) *	Television	33	26.2
	Radio	43	34.1
	Newspaper	10	7.9
	Health facility/clinic	82	65.1
	Community health worker	123	97.6
	Friends/family	19	15.1
Can list three examples of fortified foods available in the market* (N=126)	Fortified maize flour	126	100
	Fortified wheat flour	126	100
	Fortified vegetable oil	126	100
	Don't know	0	
Can identify Kenyan logo for food fortification (N= 126)	Yes	36	13
Knowledge of a micronutrient deficiency that can be addressed through fortification (N= 126)	Yes	3	2
Importance of feeding a child fortified food (N=126) *	Improves the body's ability to fight diseases	76	27.3
	Improves child appetite	35	13.8
	Improves child ability to learn and develop	35	13.8
	Makes children healthy, strong and active	57	20.9
	Prevents vitamins and mineral deficiency	35	13.8
	Don't know	10	7.9
Knowledge score(N=272) *	Low (<40)	146	53.7
	Moderate (41 – 59)	71	26.1
	High (60-80)	55	20.2

**Multiple response so total score is more than 100, Knowledge scores (correct) – high (5-6), Moderate (3-4), Low (1-2)*

4.6: Factors associated with young child feeding of fortified foods in Isiolo County

Logistic regression was used to determine the association between the various independent variables (wealth ranking, availability of foods and knowledge on food fortification) and the young child feeding of fortified foods. Cross-tabulations were conducted to examine associations between socio-economic status (SES) and consumption of fortified maize flour, caregiver knowledge level and consumption frequency, and the availability and use of fortified vegetable oil. While many associations were statistically significant ($p < 0.05$), earlier tables had only noted significance without interpretation. For example, households with higher SES were significantly more likely to use fortified flour ($p = 0.012$), suggesting that affordability and access play a major role in uptake. Similarly, knowledgeable caregivers were more likely to offer fortified foods ($p = 0.009$), indicating that awareness positively influences adoption and reinforcing the need for behavior-change interventions. Logistic regression analysis confirmed that higher SES (OR = 1.729, $p = 0.012$), caregiver knowledge (OR = 1.227, $p = 0.0089$), and food availability (OR = 1.311, $p = 0.015$) were all significantly associated with increased consumption of fortified foods.

4.6.1 Association between socio-economic status and consumption of fortified foods by young children

H_{01} *There is no significant association between HH's socio-economic status and the Consumption of fortified foods by children below two years Isiolo County*

There was a significant association between households' socio-economic status and the Consumption of fortified foods by young children. The households that had high wealth index ranking were 1.729 times more likely to feed their children fortified maize flour than those in the lower wealth index ranking (R^2 =0.57; OR =1.729; p=0.0012). The odds ratio

of consuming fortified maize flour was 1.729 times higher among children from higher economic status households compared to those from lower economic status households (P=0.012). Those who had high wealth index ranking were 1.838 times more likely to feed their children fortified wheat flour than those in the lower wealth index ranking (R^2 =0.57; OR =1.1838; p=0.009). Those who had high wealth index ranking were 1.494 times more likely to feed their children fortified oil than those in the lower wealth index ranking (R^2 =0.57; OR =1.494; p=0.016).

Table 4.9: Household's economic status and consumption of fortified foods by children

Variables		Consumption of fortified foods					
		Consume	**Did not Consume**	**Totals**	**R^2**	**OR**	**P value**
		Fortified Maize flour					
	High	18	14	32	0.57	1.729	0.012*
	Low	43	100	143			
		Fortified Wheat flour					
Wealth index ranking	High	22	10	32	0.63	1.838	0.009*
	Low	9	134	143			
		Fortified vegetable oil					
	High	27	5	32	0.51	1.494	0.016*
	Low	61	83	143			

OR = [Odds ratio value], 95% CI, p = [p-value] (Odds ratio for [wealth index] compared to [consumption])

4.6.2 Association between availability of fortified foods and consumption of fortified vegetable oil, maize and wheat flour by young children

H_{02} *There is no significant association between the availability of fortified foods and the Consumption of fortified foods among children aged 6 to 23 months in Isiolo County*

There was a significant association between households' availability of fortified foods and their consumption.

The households where fortified maize flour was available were 1.311 times more likely to feed their children fortified maize flour than those who didn't have fortified foods (R^2 =0.44; OR =1.311; p=0.015). The households where fortified wheat flour was available were 1.453 times more likely to feed their children fortified wheat flour than those who didn't have fortified wheat flour at home (R^2 =0.47; OR =1.453; p=0.013).

Among households with access to fortified oil, 56% of the children consumed it, compared to only 38% of children in households without access. The odds ratio indicates that children in households with access to fortified oil were 1.252 times more likely to consume it compared to those without access (P=0.013).

Table 4.10: Availability of fortified foods and their consumption among children aged 6-23 months.

Variables		**Consumption of fortified foods**					
		Consume	**Did not Consume**	**Totals**	**R^2**	**OR**	**P value**
				Fortified Maize flour			
	Available	58	68	126	0.44	1.311	0.015*
	Not available	40	159	146			
				Fortified Wheat flour			
	Available	27	99	126	0.47	1.453	0.011*
Availability of fortified foods	Not available	18	128	146			
				Fortified oil			
	Available	71	55	126	0.41	1.252	0.013*
	Not available	57	172	146			

4.6.3 Association between knowledge of food fortification and consumption of fortified foods by young children

***H_{03}** There is no significant association between caregivers' knowledge on food fortification and the Consumption of fortified foods among children aged 6 to 23 months in Isiolo County.*

There was a significant association between caregiver's knowledge on food fortification and the consumption of fortified foods by young children. The care givers with high knowledge were 1.227 times more likely to feed their children fortified maize flour than those with low knowledge score (R^2 =0.52; OR =1.227; p=0.0089). The caregivers with high knowledge score were 1.672 times more likely to feed their children fortified wheat flour than those with low knowledge score (R^2 =0.54; OR =1.672; p=0.0012). The caregivers with high knowledge were 1.126 times more likely to feed their children fortified oil than those with low knowledge score (R^2 =0.51; OR =1.126; p=0.021).

Table 4.11: Caregiver's knowledge and consumption of fortified foods by young children

Variables		Consumption of fortified foods					
		Consume	**Did not Consume.**		R^2	**OR**	**P value**
			Fortified Maize flour				
	High	34	21	55	0.52	1.227	0.0089
	Low	28	118	146			
			Fortified Wheat flour				
Caregivers' knowledge	High	20	35	55	0.54	1.672	0.012
	Low	12	134	146			
			Fortified oil				
	High	55	0	55	0.51	1.126	0.021
	Low	60	86	146			

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECCOMENDATIONS

5.1 Discussion

5.1.1 Introduction

This chapter presents an integrated analysis of the study findings in relation to existing literature and the study objectives. The discussion is structured around the study objectives. The chapter then presents conclusions drawn from the findings and offers recommendations for policy, programme and future research.

5.1.2 Consumption of fortified and non-fortified foods

Micronutrient deficiencies among young children remain a critical public health challenge in Kenya, highlighting the role of fortified foods in improving dietary quality. In Isiolo County, fortified maize flour and vegetable oil were consumed less frequently than non-fortified alternatives. Only 30.1% of children consumed fortified maize flour at least twice weekly, and daily use of non-fortified vegetable oil exceeded that of fortified oil. Wheat flour consumption was generally low, with fortified wheat flour consumed by only 17.5% of children.

Consumption of fortified foods increased with age, with the highest rates among children aged 18–23 months. These patterns reflect findings by Osei et al. (2016) and Leyvraz et al. (2018), who found that fortified food intake in children under two is often suboptimal despite market availability. Qualitative data from this study also revealed barriers such as cost, perceptions about “chemicals” in fortified foods, and preference for locally milled

flour echoing IFPRI (2020), which found socio-cultural preferences strongly influence uptake.

The WHO (2023) guidelines on complementary feeding emphasize integrating nutrient-dense, fortified foods to fill dietary gaps, particularly in low-diversity diets. In Isiolo, where only 24% of children meet the minimum acceptable diet, fortified foods represent an underutilized strategy for improving child nutrition.

5.1.3 Socio-economic status and its influence on consumption

Socio-economic status was significantly associated with fortified food consumption in this study (OR = 1.729, p = 0.012). Over half of households were classified as low SES, and higher SES households were more likely to purchase fortified foods. Similar patterns have been documented in Guatemala, Venezuela, and Ethiopia (De Grodetec et al., 2002; Rosalina & Kielman, 2007; Hoddinott & Yohannes, 2002).

Household leadership patterns also shape food purchasing. In Isiolo, 89% of households were male-headed, consistent with earlier local surveys. As Smith et al. (2003) and Doss (2018) note, male-headed households often control resource allocation, influencing the choice of foods purchased, including fortified products. The prolonged drought of 2021–2023 further reduced incomes, constraining the ability to purchase higher-priced fortified products.

5.1.4 Availability of fortified foods

Fortified maize flour was available in 75% of the retail outlets surveyed, while fortified wheat flour and vegetable oil had lower availability (25% and 50%, respectively). Non-fortified, locally milled products dominated rural markets, particularly in Oldonyiro. These findings reflect Harika et al. (2017), who noted that self-produced or locally processed foods can limit penetration of fortified products. Retailers cited cost and irregular supply as major barriers, in line with Ahmed et al. (2016) and GAIN (2020). Even when fortified foods were available, uptake was limited, only 37% of maize flour consumed daily by children was fortified. This mirrors Hotz et al. (2015), who found that supply alone does not guarantee consumption.

5.1.5 Caregiver knowledge and its association with consumption

Caregiver knowledge was generally low, with only 20.2% being knowledgeable. While 46% could name at least one fortified product, only 2% could identify specific nutrient benefits. These findings are consistent with Pambo (2014), who found misconceptions about fortification in Kenya, and Webb et al. (2017), who reported that knowledge alone does not ensure adoption of fortified foods.

In Isiolo, knowledge was positively associated with consumption ($OR = 1.227$, $p = 0.0089$), suggesting that behaviour-change interventions could be effective if combined with improved affordability and availability.

5.2 Conclusions

Objective 1: The consumption of fortified foods by children aged 6–23 months was significantly lower compared to non-fortified alternatives (χ^2, $p = 0.027$). Among fortified options, maize flour was the most frequently consumed; however, it reached fewer than one-third of the children surveyed.

Objective 2: Logistic regression confirmed that higher SES households were significantly more likely to purchase fortified foods. Households with limited income, compounded by recurrent drought, reported constrained purchasing power, echoing findings from Ndiku et al. (2020) that economic access remains a primary determinant of fortified food uptake. The null hypothesis that socio-economic status is not associated with fortified food consumption was rejected.

Objective 3: The study established inconsistent availability of fortified wheat flour and vegetable oil, while non-fortified, locally milled products were widely accessible and cheaper. This is consistent with the Kenya Food Fortification Strategy (2021), which notes that small-scale milling and limited market penetration of fortified products are key challenges in ASAL contexts. The null hypothesis that market availability does not influence fortified food consumption was rejected.

Objective 4: The study found that knowledge on food fortification was generally low, with misconceptions such as fears that fortified foods cause illness contributing to low uptake. These results corroborate with UNICEF (2023) guidance that awareness campaigns must

be coupled with accessibility to achieve behavioral change. The null hypothesis that caregiver knowledge and perceptions have no effect on fortified food consumption was rejected.

The rejection of all null hypotheses confirms that economic access, market supply, and caregiver knowledge are interlinked determinants of fortified food consumption. These findings are consistent with the WHO (2023) framework on complementary feeding, which emphasizes affordability, availability, and awareness as the drivers of improved child nutrition.

5.3 Recommendations

5.3.1 Recommendations for policy

1. A policy to ensure that miller and producers comply with fortification standards

5.3.2 Recommendations for practice

1. Strengthen last-mile distribution of fortified foods via cooperatives and community traders, led by the County Trade Department and manufacturers and Health ministry.
2. Embed fortification awareness into antenatal, postnatal, and child welfare sessions through trained health workers, led by the Ministry of Health and County teams.
3. Launch voucher/subsidy programs through local retailers to make fortified foods affordable for low-income households, coordinated by County Government, Health and Agriculture ministries, and donors.

5.3.3 Recommendations for further research

1. Study seasonal variations in fortified food consumption among households with young children in Isiolo.

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APPENDICES

APPENDIX A: CONSENT FORM

Good morning / Good evening, Madam / Sir,

My name is Emily Mkungo, I am a master's student from Kenyatta University. I am conducting a study titled "Consumption of fortified foods and associated determinants among children aged 6-23 months in Isiolo County". The information will be used by the Ministry of Medical Services and Ministry of Public Health and sanitation to improve access to and consumption of fortified foods among children and effectiveness of food fortification intervention in Isiolo and largely Kenya.

Procedures to be followed.

Participation in this study will require that I ask you some questions and I also confirm presence of fortified foods in your household if any.

The first part of the interview will be about the composition of the household, including all its members. The second part will focus on the child. If there is more than one child less than 5 years of age, then I will select the youngest. I will then ask the mother/caregiver of the child some questions about what she and the child ate yesterday and foods purchased and prepared in the household.

Voluntarism

You have the right to refuse participation in this study. You will get the same services and care whether you agree to join the study or not and your decision will not change the care you will receive. Please remember the participation in this study is voluntarily. You may ask questions related to the study at any time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you receive here or any other organization now or in the future.

Discomforts and Risks

Some of the questions you will be asked are on intimate subject and may be embarrassing or make you uncomfortable. If this happens, you may refuse to answer these questions if you so choose. You may also stop the interview at any time. The interview may add approximately half an hour.

There are risks associated with participating in this survey because of the possibility of transmission of the coronavirus. The coronavirus can be spread through droplets in the air when an infected person coughs, sneezes or speaks, or by touching a contaminated surface and then touching your eyes, nose, or mouth before washing your hands. Our team will take precautions to mitigate the risk of spreading the virus, such as wearing a face covering, standing at least one meter apart throughout the interview and washing/sanitizing hands before and after.

Benefits

If you participate in this study, you will help us to learn how to improve access to and consumption of fortified foods for children under five years. You will also benefit from learning the importance of feeding young children fortified foods which are aimed at improving or boosting micronutrient consumption among children.

Reward

There will be no reward in participation to this study.

Confidentiality

The interviews will be conducted within your household setting. Your name will not be recorded on the questionnaire. The questionnaires will be kept in a locked cabinet for safe

keeping at Kenyatta University. Everything will be kept private and only shared with the study team.

Your privacy is important to us. No part of this interview will be recorded or videoed. If you agree to participate, some of the information you provide will be available on a public website that researchers and others will be able to access without identifying you. The information will be entered into a database that will NOT contain confidential information such as your name or the name of your village that could be used to identify you.

Contact Information

If you have any questions, you may contact researcher's supervisor: Prof. Peter Chege by telephone at +254-722642356/ or Dr. Judith Munga by telephone at +254-722974465. However, if you have questions about your rights as a study participant: You may contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke,

Participant's statement

The above information regarding my participation in the study is clear to me. The study has been explained to me and I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will still get the same care and medical treatment whether I decide to leave the study or not and my decision will not change the care that I will receive from the clinic today or that I will get from any other clinic at any other time.

Name of Participant: ____

Signature or Thumbprint Date

__________________________ ____________________________________

Name of Representative/Witness (where necessary) Relationship to Subject

Investigator's statement

I, the undersigned, have explained to the volunteer in a language s/he understands, the procedures to be followed in the study and the risks and benefits involved.

____

Name of Interviewer ______________________________________

Signature Date

APPENDIX B: HOUSEHOLD QUESTIONNAIRE

Consumption of Fortified Foods and Associated Determinants among Children Aged 6-23 Months in Isiolo County

This tool has been adopted and customized from Fortification Assessment and Coverage Toolkit (FACT)[1].

1. *Household Identifying Information*

1.1 Ward Name: _______________
1.2 Village Name: ____________________
1.3 Household number: ________________________

2. *Household structure*

2.1 Gender of household head
a) Male
b) Female

2.2 What is the main occupation of the household head
a) Livestock herding
b) Farmer/own farm labor
c) Employed (salaried)
d) Daily labor/Wage labor
e) Small business/Petty trade
f) Other (Specify _____________

2.3 Age of mother or caregiver
a) 15 – 35 years
b) 36 – 45 years
c) Above 45years

2.4 Mothers or caregivers' level of education
a) No formal education
b) Less than primary school
c) Primary school
d) Secondary school
e) College/University
f) Postgraduate school

1 FACT: The Global Alliance for Improved Nutrition (GAIN) developed the Fortification Assessment Coverage Toolkit (FACT) in 2013 for carrying out coverage assessments of fortification programs.

	Objective 1: Consumption of fortified foods by children below 2 years of age					**Skip**
		Options	Vegeta ble oil	Wheat flour	Maize flour	
1.1	How many days has your child consumed non-fortified foods in the last 7 days?	Days				
1.2	Has your child consumed non-fortified foods in the last 24 hours	Day				
1.3	Has your child consumed fortified foods in the last 24 hours	Day				
1.4	How many days has your child consumed fortified foods in the last 7 days?	Days				
1.5	Fortified versions - show the packaged examples with the logo	Options	F/Veget able oil	F/Whea t flour	F/Maize flour	
1.6	In your opinion, should an infant be feed fortified foods	Yes				
		No				
1.7	Please explain reason for response					

	Objective 2: Availability of fortified foods and young child feeding of fortified foods				
	Fortified versions only	Options	Vegetable oil	Wheat flour	Maize flour
2.1	Are fortified foods available in the local market	1Yes, 2 No			
2.2	When fortified vegetable oil, wheat flour, maize flour is available, does your child automatically consume these foods	1Yes, 2 No			
2.3	If you have any of these fortified foods in your household, could you please bring them out here now?	Please mark for all food seen at the HH to include Asili and Jenna brands(local)			
2.5	The last time your household got fortified foods, where did you get it from?	a) Market	b) made at home	c)relative or friend	d) Other: (specify)
2.6	The last time your household got fortified foods, did you get it in its original package or not?	a) Original package	b) Not in original package	c) Other (specify)	
2.7	The last time your household got fortified foods, what was the brand?	With Kenyan fortification logo	Without fortification logo	Other (specify)	Please also mention local brands here (jenna or asili)

Objective 3: Household's social economic status and young child feeding of fortified foods		
No	Questions	Answer
3.1	Does any member of your household own any agricultural land?	a) Yes b) No

Objective 3: Household's social economic status and young child feeding of fortified foods		
No	Questions	Answer
3.2	Does this household own any livestock, herds, other farm animals, or poultry?	a) Yes b) No
3.3	How many [animal] does the household own? **If none record 00 under G**	[A] ANIMAL 1 ………………………... [B] ANIMAL 2 ………………………... [C] ANIMAL 3 ………………………. [D] ANIMAL 4 ………………………... [E] ANIMAL 5 ………………………..... [F] ANIMAL 6 ………………………..... [G] Other (specify): ___________
3.4	Does your household have electricity	a) Yes …………………… b) No ………………………..
3.5	What is the main material of the floor of the dwelling? **(OBSERVATION)** CIRCLE ONLY ONE ANSWER.	a) Wood. . . . . b) Cement . . . . c) Tiles . . . . d) Mud . . . . e) Nothing . . . . f) Other (specify): ____________________
3.6	What is the main material of the roof of the dwelling? **(OBSERVATION)** CIRCLE ONLY ONE ANSWER.	a) No roofing . . . . b) Concrete . . . . c) Tiles. . . . . d) Roofing sheet. . . . . e) Grass . . . . f) Other (specify): ______________
3.7	What is the main material of the exterior walls of the dwelling? **(OBSERVATION)** CIRCLE ONLY ONE ANSWER.	a) No walls . . . . b) Cement blocks . . . . . . …... . . . . c) Bricks. . . . . …….…… . d) Wood ……….. . . . . e) Dry mad. . . . . ……. f) Reed/straws/sticks . . . . …….. . . g) Other (specify): ___________________
3.8	What is the main source of drinking water for the members of your household? CIRCLE ONLY ONE ANSWER.	a) Water piped into dwelling . . . . b) Water piped into neighbor's dwelling /yard/plot . . . . . c) Public tap/standpipe. . . . . d) Borehole. . . . . e) Well . . . . f) Spring water . . . . g) Surface water ……………………. h) Bottled water . . . . i) Other (specify): ____________________

Objective 3: Household's social economic status and young child feeding of fortified foods		
No	Questions	Answer
3.9	What kind of toilet facility do members of your household usually use? CIRCLE ONLY ONE ANSWER.	a) Toilet with flush system . . . . b) Ventilated improved pit latrine . . . . c) Pit latrine with slab . . . . d) Pit latrine without slab/open pit . . . . e) No facilities/bush/field . . . . f) Other (specify): ______________________
3.10	Has having income or money to purchase food influenced your purchase of fortified foods	a) Yes……………………….. b) No………………………..

Objective 4: Caregiver's knowledge on food fortification and young child feeding of fortified foods		
No	Questions	Answer
4.1	Do you know the Kenyan logo of food fortification	a) Yes b) No
4.2	Have you ever heard about fortified foods? SHOW FORTIFICATION LOGO TO THE RESPONDENT.	a) Yes ……………………… b) No ……………………….. **Please note** other fortified foods that the family will present that are Kenyan produced but don't have government logo such as Jana and Asili plus brands that are produced in Meru and very common in Isiolo
4.3	Where did you see/hear about it?	a) Television …………………………… b) Radio ……………………............. c) Newspaper/magazine ……………. d) Campaign of department of health ………………… e) Health facility/clinic …………… f) Community workers ……………... g) Friends/family …………………… h) Other (specify)…………………..
4.4	Importance of feeding a child fortified food	a) Improves body's ability to fight diseases Good for health … b) Improves child appetite…………………… c) Improves child ability to learn and develop ……… d) Makes child healthy, strong and active ……………

Objective 4: Caregiver's knowledge on food fortification and young child feeding of fortified foods		
No	Questions	Answer
		e) Prevents vitamins and mineral deficiency ………………… f) The food is good for growth and development of children …… g) Don't know ……………………
4.5	List three examples of fortified foods available in the market*	a) Maize flour b) Wheat flour c) Vegetable oil d) Others(specify)
4.6	Knowledge of a micronutrient deficiency that can be addressed through fortification	a) Vitamin A deficiency b) Vitamin D deficiency c) Iron deficiency d) Zinc deficiency e) Other(specify)

********END OF INTERVIEW- THANK THE RESPONDENT

APPENDIX C: FOCUS GROUP DISCUSSION GUIDE

Consumption of Fortified Foods and Associated Determinants Among Children Aged 6 To 23 Months in Oldonyiro Location, Isiolo County

1.1 Ward Name: ______________
1.2 Village Name: ___________________

The interview will be tape-recorded. Information obtained from the participant(s) will be treated with confidence and only used for the purposes of this study. Anonymity will be guaranteed.

1. Have you heard about food fortification
2. Where did you hear it from (For those who responded yes in Q1)
3. What do you understand by food fortification? (For those who responded yes in Q1)
4. Should children consume fortified foods? (give an example of fortified food)
5. What are the challenges households face in accessing fortified foods.
6. Are there any awareness sessions on food fortification done in the location, by who? Does it influence food choices caregivers make? (The follow-on question wasn't asked based on no responses)
7. Are fortified foods available in the markets (interviewer to give examples)
8. Does consumption of fortified foods between other household members and children differ (For those who responded yes in Q1)
9. What are some of the barriers to consumption of fortified foods especially for children.
10. What do you recommend can be done to improve uptake of fortified foods.

********END OF INTERVIEW- THANK THE RESPONDENTS

APPENDIX D: KEY INFORMANT INTERVIEW GUIDE (FOOD STOCKIST)

Consumption of Fortified Foods and Associated Determinants Among Children Aged 6-23 Months in Isiolo County

1.3 Ward Name: _______________
1.4 Village Name: ____________________
1.5 Market Name: ________________________

Information obtained from the participant(s) will be treated with confidence and only used for the purposes of this study. Anonymity will be guaranteed.

Food items	Fortified	Price	Non-fortified	Price
Maize flour				
Wheat Flour				
Vegetable oil				

Open ended: What influences your stock choices?

APPENDIX E: KEY INFORMANT INTERVIEW GUIDE

Consumption of Fortified Foods and Associated Determinants among Children Aged 6-23 Months in Isiolo County

Ward Name: _______________
Village Name: ____________________

E1	What do you know about food fortification. Does the community in Oldonyiro and Ngaremara feed children fortified foods? **Probe:** i. Are there structures in place to promote consumption of fortified foods? ii. If there are structures, who has placed these, MOH or partners?
E2	E2: What is the status of these structures **Probe:** i. Any success, what has contributed to the success ii. Any challenges and what could be the possible solutions

APPENDIX F: GRADUATE SCHOOL APPROVAL

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School

DATE: 6th January, 2022

TO: Ms. Emily Chao Mkungo
C/o Department of Food, Nutrition & Dietetics

REF: H60/CTY/PT/2689/2018

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 29th November, 2021.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

Thank you.

KENYATTA UNIVERSITY OFFICE OF DEAN 13 JAN 2022 GRADUATE SCHOOL P.O. Box 43844-00100 NAIROBI

JACKSON LUVUSI
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Department of Food, Nutrition & Dietetics

Supervisors:

1. Dr. Peter M. Chege
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   Kenyatta University

2. Dr. Judith Munga
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   Kenyatta University

APPENDIX G: ETHICAL CLEARANCE

KENYATTA UNIVERSITY
CENTRE FOR RESEARCH ETHICS AND SAFETY

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Tel: 8710901/12

Our Ref: **KU/ERC/APPROVAL/VOL.1**

Date: 5th /04/2022

Emilly Mkungo
P.O Box 43844, 00100
Nairobi.

Dear Mr. Mkungo,

APPLICATION NUMBER: PKU/2464/I1596 - CONSUMPTION OF FORTIFIED FOODS AND ASSOCIATED DETERMINANTS AMONG CHILDREN AGED 6-23 MONTHS IN ISIOLO COUNTY, KENYA

This is to inform you that ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** has reviewed and approved your above research proposal. Your application approval number is **PKU/2464/I1596.** The approval period is **5th *04/2022 to 5th /04/2023***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.

vii. Submission of an executive summary report within 90 days upon completion of the study to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following website link; ;(https://docs.google.com/forms/d/1ytWefDwvyz5h1oz_VIn0xbxg3uGdlDzMXFWNDsMrRPQ/edit?usp=sharing

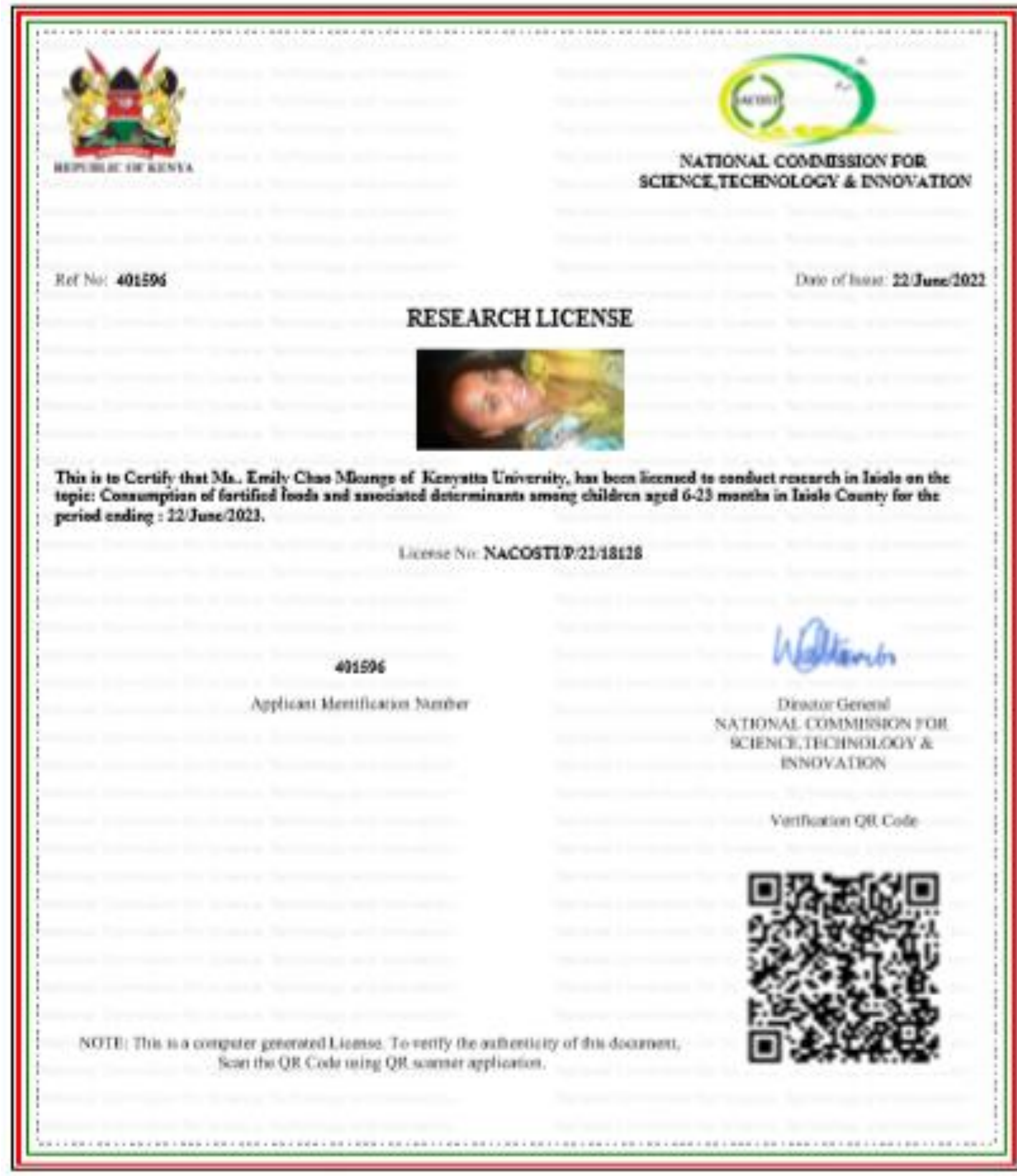
Yours sincerely

KENYATTA UNIVERSITY
CHAIRMAN
05 APR 2022
ETHICS REVIEW COMMITTEE
P.O. BOX 43844 - 00100 NAIROBI

Prof. Judith Kimiywe

Director: Centre for Research Ethics and Safety

APPENDIX H: RESEARCH PERMIT



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 401596

Date of Issue: 22/June/2022

RESEARCH LICENSE

This is to Certify that Ms.. Emily Chao Mbunge of Kenyatta University, has been licensed to conduct research in Isiolo on the topic: Consumption of fortified foods and associated determinants among children aged 6-23 months in Isiolo County for the period ending : 22/June/2023.

License No: NACOSTI/P/22/18128

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Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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APPENDIX I: STUDY AREA